

Bringing Agroforestry Technology to Farmers in Leyte, the Philippines: A Comparison of Two Extension Assistance Regimes

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Abstract The response of farmers to personalised forestry and agroforestry extension assistance has not been well documented in the Philippines, thus providing the impetus for this research in which the effectiveness of extended on-farm assistance was compared with more limited assistance. In four municipalities in Leyte Island, farmers responded positively to an extended program which helped them overcome problems in germinating and growing seedlings and establishing trees on their land. A limited assistance program which sought to make use of farmers' familiarity with growing and raising plants was relatively unsuccessful, with less preparation of tree planting sites and a higher rate of abandonment. Allowing farmers freedom to select planting sites and aspects of technical advice which suited their personal circumstances, encouraged a high degree of cooperation between extension staff and farmers, but 38% of farmers neglected post-planting weed control and 35% of sites were inappropriate for growing trees. Destruction of sites by flooding and grazing also caused farmers to blame extension staff even though these risks had been discussed with them beforehand. This suggested that a more interventionist approach would be appropriate for site selection although it may reduce recruitment. The number of farmers recruited through local government staff was low, but attendance by neighbours at locally held demonstrations was high, suggesting an avenue for further recruitment. Overall, the program was successful in shifting the initiative for further planting from extension staff to those farmers who received extended extension assistance.

Keywords Self-efficacy · Small-scale nursery · *Swietenia macrophylla* · Home nursery

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Introduction

The imperative for reforestation in the Philippines is well recognised (Harrison et al. 2000) and was the impetus for a recently completed extension program which was undertaken on Leyte Island as one of the activities of the Australian Centre for International Agricultural Research (ACIAR) project ASEM/2003/052, *Improving Financial Returns to Smallholder Tree Farmers in the Philippines*. The program was designed to assist smallholders to grow timber trees on their land and the focus of this paper is an evaluation of the results of the program.

The background to the extension program is that following uncontrolled logging of native forest on the island of Leyte over the last 50 years, large-scale sawmilling has collapsed (Severino 2000), with native forest now mainly confined to inaccessible and remote areas. Currently, timber is either imported or sourced from cocolumber sawmills on roadsides which produce low-quality timber for domestic use. However, some farmers have planted timber trees, either as monocultures or intercropped with cash crops (e.g. maize, vegetables), coconut palms, fruit trees or the shade tolerant abaca palm (*Abaca musilis*). In the rural landscape, their main competitor for land use is coconuts. One of the main species used for timber plantations is mahogany (*Swietenia macrophylla*).

The scattered occurrence of tree farms suggests that agroforestry is not feasible for Filipino farmers. The seed supply for semi-commercial nurseries in the central and southern Philippines is a perennial problem (Carandang et al. 2006). In Leyte, lack of availability and low quality of planting stock are restricting the uptake of agroforestry, seedlings used in most smallholder plantings being of such a low quality that mortality is high and growth poor (Gregorio et al. 2004, 2007). Insecure property rights also act as an impediment to plantation establishment (Venn et al. 2001).

The silvicultural management of existing stands is often poor. In even-aged woodlots, farmers' reluctance to thin their plantations results in slow tree growth which reduces profitability (Bertomeu et al. 2006). Farmers typically harvest the largest trees in a stand first, resulting in a degraded plantation (Harrison and Herbohn 2000). A bolo (machete) is traditionally used to prune trees and the resulting long branch stubs are susceptible to fungal infection, resulting in poor tree health (Peque 2003).

The uncertain profitability of long-term crops causes many farmers in the Philippines to prefer annual or short-term crops because they need cash income (Snelder et al. 2007). Hence, choosing an appropriate approach to agroforestry extension assistance is difficult because while biophysical aspects of tree growing are well described in the literature, little is known about farmers' potential enthusiasm for growing timber trees or their understanding of nursery and tree establishment technology. In other parts of the Philippines, government and non-government agencies have initiated forest management and tree planting programs. However, in Leyte, farmers have little access to agroforestry extension information or assistance. This suggests that providing assistance to them to produce high-quality seedlings and then establish plantations may improve the uptake of small-scale tree planting. As a complementary activity, assistance to use appropriate

pruning and thinning methods may improve the health and growth of the trees. Stands treated in this way may then serve as a model for other tree growers.

The initial focus of other agroforestry extension programs has often been seedling production, but approaches vary. Russell and Franzel (2004) found central publicly funded nurseries in Kenya to be expensive, whereas in Haiti, Murray and Bannister (2004) expressed a strong preference for professionally grown seedlings. Similarly, for the 'Good Roots' program in the Philippines, Wallace (2006) regarded a main nursery as essential to support subsidiary nurseries and tree planting programs in villages. However, balsa plantations in Papua New Guinea have been promoted by the International Tropical Timber Association with a do-it-yourself nursery manual for villagers (Howcroft 2002).

The rationale for the extension program reported in this paper was that initial progress in long-term adoption of smallholder forestry are most likely to be achieved through the provision of technical advice which assists farmers to help themselves, in this case to raise seedlings in home nurseries and to grow the trees on their farms. Farmers would be free to choose technical information and adapt it to their personal circumstances.

This paper describes the evaluation of an extension program on Leyte Island in which home nursery, tree establishment, thinning and pruning technology was offered to smallholders in the municipalities of Libagon, Dulag, Bato and Leyte Leyte, between September 2005 and December 2007. Because little was known about whether or how farmers would respond to extension assistance, data collection tracked farmers' actions throughout the program to provide a chain of quantitative and qualitative evidence. Using four criteria, the paper describes the design and delivery of the program and evaluation of the results for future program expansion.

Design of the Research Program

Local government units (LGUs) in the Philippines exert a strong influence over the lives of villagers and permission to enter and engage with local communities is obtained from barangay captains¹ and municipal mayors. Consequently, permission to recruit farmers was first obtained from municipal mayors in liaison with the Department of Environment and Natural Resources (DENR). Written invitations for farmers to be included in the extension program were then distributed to barangay captains who informed farmers of the offer of extension assistance. For farmers in Libagon and Dulag LGUs (Fig. 1), extension assistance was offered in 2005 and 2006 and for farmers in Leyte Leyte and Bato LGUs extension assistance was offered in 2006 and 2007.

Because the cost-effectiveness of agroforestry extension is increased if farmers develop the capability to produce seedlings without extensive training, the extension program was offered in two regimes to test the necessity for extended assistance. In an *extended assistance* regime, farmers were offered on-site assistance to collect

¹ A *barangay* is the smallest unit of local government in the Philippines, and is equivalent to a village.

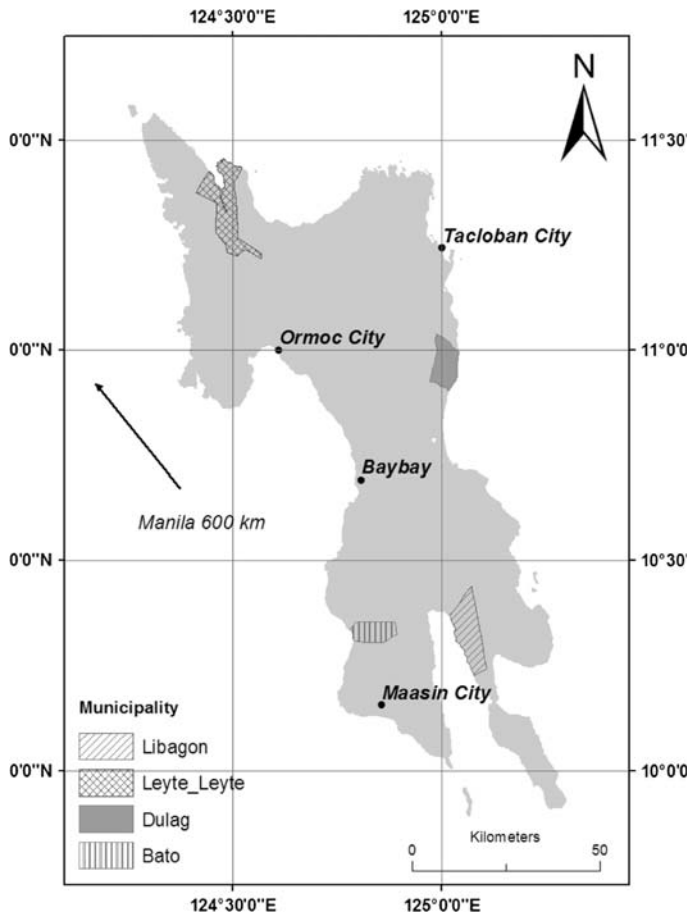


Fig. 1 Map of Leyte island showing principal cities and the municipalities of Libagon, Leyte Leyte, Dulag and Bato in which the extension program was undertaken

seed, grow seedlings, prepare sites and establish trees. In a *limited assistance* regime, farmers were only offered assistance to collect seed and grow seedlings. The extension program was undertaken as four case studies of farmers' response to the differing levels of assistance. In Libagon and Dulag, farmers were offered extended assistance and in Bato and Leyte Leyte, farmers were offered limited assistance (Fig. 2).

For both regimes, assistance was offered in sequential steps which were timed to coincide with the ripening of mahogany seed in the months of December to February. Farmers were recruited in the months of July to October and taken on a field tour which provided them with an introduction to nurseries, silviculture, marketing, and timber harvesting legislation. In Leyte, field tours or 'cross visits' are an established extension technique in which farmers inspect other farmers' practices and have discussions with technical experts (Balbarino et al. 2002).

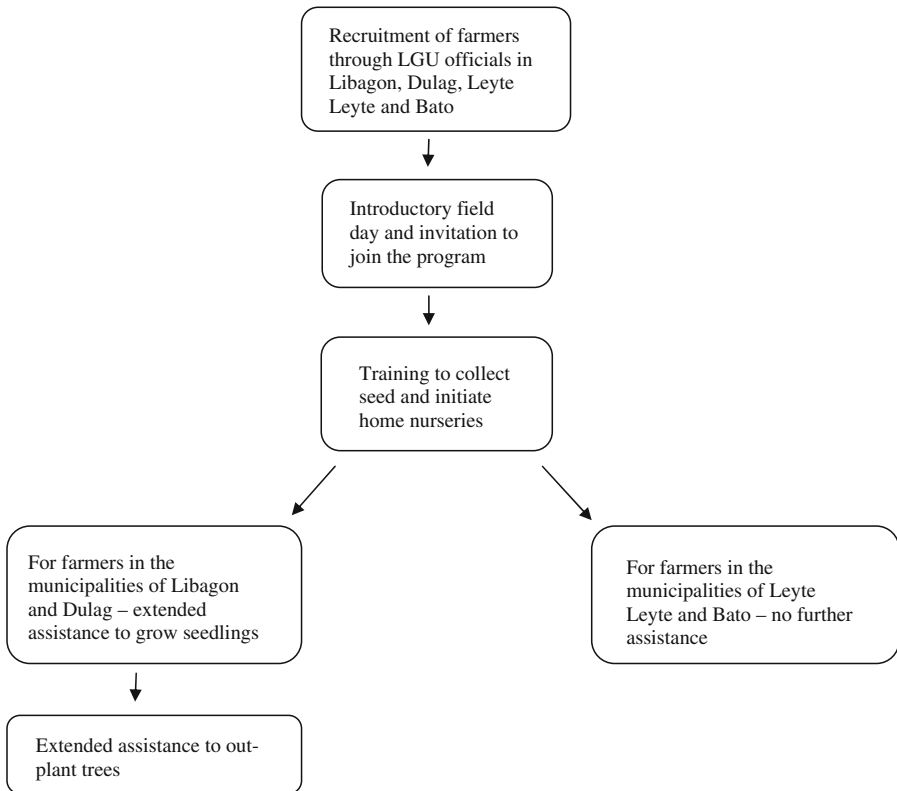


Fig. 2 Stages in the conduct of the extension program, showing the delivery of extended extension assistance to farmers in the municipalities of Libagon and Dulag but not Leyte Leyte and Bato

Because farmers could only be expected to be absent from their farms for a day, the information which could be delivered at the field tours was limited. Hence, at the end of the tour, farmers were asked whether they wished to be involved in the program and arrangements were made to visit them in their homes to discuss further technical assistance. In following weeks, interviews were held with 45 farmers from all four municipalities to establish that they owned land on which they wished to grow trees and that there were no impediments to their involvement in extension activities. Arrangements were then made to schedule further extension assistance.

In Libagon, Bato and Leyte Leyte, two extension staff obtained permission to collect seed pods from local stands of mature mahogany trees and farmers were invited to join an excursion to collect seed. From trees of superior growth and form, farmers were shown how to collect seed pods, extract the seed and dry and store it so as to maintain seed viability. Unfortunately, mature trees could not be found in Dulag and farmers in this municipality were supplied with seed collected in Libagon.

By February 2006 for farmers in Libagon and Dulag and by 2007 for farmers in Leyte Leyte and Bato, all farmers had been visited and shown how to mix potting

soil and set up and maintain a home nursery. As a small motivational gesture, farmers were given several seedling trays or 100 polybags. At this stage, all farmers had attended two interactive demonstrations of setting up a home nursery and one demonstration of setting out, planting and maintaining trees in the field. Farmers in Bato and Leyte Leyte were not re-visited until the end of the program but farmers in Libagon and Dulag were offered assistance to plant and stake their trees. The visits were scheduled after farmers had cleared planting sites of competing vegetation and had burnt or cultivated the site to remove excess growth of the perennial grass *Imperata cylindrica* (imperata). All farmers were revisited for a final interview, 1 year after planting in Libagon and Dulag and 6 months after planting in Leyte Leyte and Bato.

Research Method

Data collection was carried out in conjunction with each extension activity and included written reports by extension staff and visual observations by visiting Australian researchers. Data were collected about farmers' participation, commitment and compliance with instructions and advice. Records were kept of seedling germination, losses through disease or predation and number of seedlings which were out-planted. Records were also kept of the location, slope and fertility of each planting site, the site preparation and weed control which farmers employed, and seedling height at 1 year of age. ACIAR staff also held a mid-program workshop to review extension activities and to make recommendations for future programs. Farmers were also asked to evaluate the effectiveness of program activities during a final on-site inspection, and extension staff classified each site according to the risk of damage from fire,² flood³ and typhoon,⁴ as well as difficulty of access and density of overstorey canopy. Extension staff also recorded the regularity of site maintenance, mainly the slashing of weeds. To check that invitations had reached the total cohort of farmers who may be interested in growing trees, 1 year after the initial plantations had been established, signs were erected in Libagon and Dulag which invited passers-by to contact ACIAR for extension assistance.

The extension program was evaluated according to four criteria. First, the recruitment process was evaluated according to the number of farmers who were recruited and the potential for further recruitment. Second, farmers' responses to extension techniques and the delivery of technical information were used as a guide to the extension and teaching methodology which would be appropriate for a scaled-up program. Third, farmers' enthusiasm and commitment to the establishment and maintenance of trees were analysed to determine whether they were genuinely

² Fire is a major cause of loss of planted forest in the Philippines, deliberate burning of grassland or rice straw often leading to fire escape into the forests (Dart et al. 2001).

³ River banks are susceptible to flooding during typhoons and young seedlings particularly are liable to be washed away.

⁴ The central Philippines is affected by severe typhoons with a frequency for any particular area of one in every 3–4 years (Dart et al. 2001). Sites which are situated adjacent to rice fields are prone to typhoon damage because the water table is high for most of the year and trees do not develop deep roots.

Table 1 Participation in extension activities by smallholders in four municipalities in Leyte

Municipality	Farmers who attended field tour	Farmers who participated in training program	Farmers who planted seedlings	Site survival at 12 months
Libagon	16	13	12	11
Dulag	11	9	7	3
Leyte Leyte	14	9	3	n/a
Bato	11	9	6	n/a
Total	52	40	28	n/a

interested in growing trees or just interested in the program for whatever material benefits it may bring. Finally, the success of the program was assessed in terms of potential to shift the initiative for further reforestation from extension staff to farmers. This criterion was defined as the development of farmers' self-efficacy, i.e. confidence that they could raise seedlings and establish trees in the future.

Results and Evaluation of the Effectiveness of the Extension Program

Because the extension program was conducted as case studies of the effect of extended and limited assistance, each in two municipalities, four sets of data were collected overall. In this paper, data have been amalgamated where appropriate and only differentiated where necessary to show differences between the results achieved by the two assistance regimes.

Farmer Recruitment and Demographic Characteristics

Overall, 52 farmers from 36 barangays in the four municipalities attended the field tours and 40 participated in the program (Table 1). The principal reason for farmers not joining the program after the field tour was that they were tenants or co-owners and could not come to an agreement about the harvesting of trees with the other parties involved. The number of farmers taking part in extension activities declined throughout the program, attrition mainly being caused by failure of home nurseries and destruction of planted seedlings by flood, fire and grazing animals.

The demographic characteristics of the volunteer-farmers in all four municipalities were similar and each group included farmers who were community leaders, being past or present local organisation office-bearers. The average age of farmers in the municipalities ranged between 47 and 55⁵ (Table 2), and overall 43% of the farmers had part-time employment or were semi-retired. In all municipalities, both the number and the area of the farms indicated that a relatively wealthy cohort of farmers had been selected, compared to poorer smallholders who are often tenants rather than landowners. Although 33% of farmers had received some form of

⁵ The overall range of farmer's ages was 35–74.

Table 2 Demographic characteristics of smallholder participants in the extension program

Demographic characteristic	Municipality			
	Libagon	Dulag	Leyte Leyte	Bato
Average age (years)	53	55	47	55
Average area of farms (ha)	6.1	3.1	17.3	4.0
Average number of farm holdings	3	3	1	2
Main farm crop	Coconuts	Coconuts	Coconuts	Coconuts
Received prior agricultural training (%)	14	10	10	33
Present or past LGU office-bearers (%)	38	56	33	67

agricultural training or had been involved in previous aid projects, almost all of the training had been of 1 day duration or less.

Findings from Initial Interviews with Farmers

After the field tour, analysis of interviews with the 45 farmers who had indicated interest in the program, revealed that they now perceived few barriers to tree planting. Because the farmers may have been reluctant to supply information about their personal circumstances the questions were phrased as four general themes:

- What are the main reasons for farmers wanting to grow trees?
- What are the main constraints to growing trees?
- Which problems can farmers overcome by themselves?
- Which problems are beyond farmers' capacity to overcome?

Overall, 95% of farmers wished to sell their trees when these had reached a marketable size, to use them for house timber, or to treat them as a bequest. Lack of seed or seedlings was cited a major constraint to the establishment of plantations by 70% of farmers. Farmers' lack of awareness of the requirements of DENR harvesting legislation appeared to have been successfully addressed during the field day, because only 24% of the interviewees considered that compliance with the legislation may cause them problems in the future. Damage to trees from fire or grazing was almost universally seen as a threat until the trees were established. Although only 63% of farmers had secure and sole title to their land, the remainder indicated that they could negotiate with other family members or co-owners to plant and harvest trees.

Scheduling of Extension Activities

Recruitment of farmers in Libagon, Leyte Leyte and Bato proceeded with the cooperation of LGU staff who undertook to distribute notices advising of impending visits. Farmers showed a reluctance to prioritise meetings with extension staff, and in many cases extension staff were unable to arrange to visit planting sites before the trees had been planted. In order to collect data on the growth of seedlings and

the progress of out-planting, it became necessary for extension workers to visit farmers at their houses to schedule subsequent visits.

Participation in extension activities was also lower when activities were not located at sites close by to farmers' homes. The seed collection excursion was designed to show farmers where seed could be found in succeeding years and farmers were asked to travel to the seed collection site. Extension staff commented that heavy rain on all three excursions may have reduced attendance, particularly in Leyte Leyte where attendance was only 33%. It was evident that some farmers wished to be given seed rather than collect it themselves. In contrast, the nursery demonstrations were held at host farmers' homes at a location convenient to two or three farmers, and attendance was almost 100%. For those farmers who had already planted trees, an offer was made to demonstrate pruning or thinning techniques. Not one farmer in all four municipalities accepted the offer and it was apparent that these silvicultural techniques were not of interest to them.

Extension staff advised host farmers that neighbours were welcome to attend the nursery demonstration and as many as 18 people attended and participated in the demonstration. Many of the neighbours asked for mahogany seed and polybags. Unfortunately, time constraints did not permit recruitment of neighbours into the program. However, extension staff commented that neighbours may represent a cohort of farmers who could be recruited if the opportunity arose.

Farmers' Success in Growing Seedlings in Home Nurseries

In Libagon and Dulag, the months in which farmers raised seedlings (November 2005 to March 2006) were unusually wet, with rain falling almost every day. Consequently, home nurseries which were not protected from the rain had little chance to dry out. Fungal infections rotted seeds or killed seedlings in almost every nursery and predation by chickens and rats was severe for seedlings which were placed on the ground. Also, some seedlings became desiccated when farmers neglected to water them. In contrast, the weather was fine when farmers were germinating and growing seedlings in Leyte Leyte and Bato (November 2006 to February 2007) and the main causes of seedling loss were desiccation and predation.

Differences between weather conditions in the two pairs of municipalities provided an opportunity to evaluate the effect of extended assistance. Nursery hygiene had been included in preliminary training for farmers in all four municipalities. However, in Libagon and Dulag, the problem with seedling fungal infection became so severe that extension staff visited farmers three times, during which they advised to discard soil in which seedlings had rotted and to sow a fresh batches of seed. Farmers responded to advice to elevate seedlings above ground level and hence increase air-flow and to move seedlings from the reach of chickens and rats. Extension staff reported that without multiple visits to each nursery and personal encouragement, many farmers would have abandoned efforts to grow seedlings and the extension program may have collapsed. In Libagon and Dulag, repeat visits helped to lift the success rate of nurseries growing more than 50 seedlings to 86% compared with 72% in Leyte Leyte and Bato. In these latter two

municipalities, the lack of contact with extension staff appeared to have resulted in a loss of enthusiasm.

Tree Planting and Survival Rates

Although only 27% of farmers in Libagon and Dulag accepted an offer of assistance from extension staff to set out, plant and stake trees, the farmers who accepted this assistance told extension staff that this activity was new to them and they valued being shown the correct procedures. In all four municipalities, many farmers had planted seedlings in positions adjacent to coconut palms where the seedling would be suppressed. The percentage of sites which were ploughed, fenced and fertilised was higher in the two municipalities in which extended assistance was provided (Fig. 3).

Notwithstanding the high level of acceptance of extension advice, a final on-site survey revealed that weed control had been maintained on only 62% of sites in Libagon and Dulag. On the remainder of the sites, weeds were competing with the new seedlings and restricting their growth.

In all four municipalities, the low average number of trees planted (136 trees for Libagon and Dulag and 115 for Leyte Leyte and Bato, Table 3) reflects the limited space on individual farms for timber trees. One site was burnt in Libagon and in Dulag the trees on three sites were washed away by a flood. After these events, the owners refused to have any more contact with extension staff. Grazing of seedlings on another site provoked a similar reaction from the owner. Consequently, in Dulag the positive publicity emanating from the excellent growth of trees on three sites was balanced by the destruction of trees on four other sites.

Tree growth rate was noticeably less on infertile sites which were eroded and dominated by *imperata*. The mean heights of 30 (1 year old) mahogany trees on four

Fig. 3 Levels of site preparation in Libagon and Dulag (extended assistance) and Leyte Leyte and Bato (limited assistance)

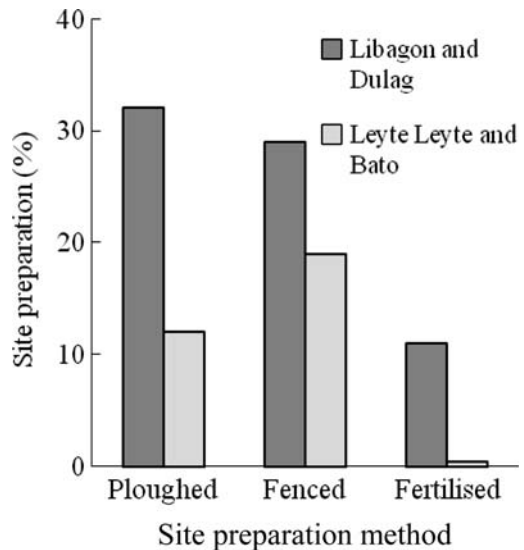


Table 3 Summary tree planting statistics

Site characteristic	Municipalities of Libagon and Dulag	Municipalities of Leyte Leyte and Bato
Number of sites planted	19 (86%)	9 (53%)
Mean number of trees planted	136	115
Site survival after 6 months	19 (100%)	9 (100%)
Site survival after 12 months	14 (74%)	Not visited

Table 4 Characteristics of sites chosen by farmers for reforestation

Municipality and number of sites	Infertile or eroded and steep (%)	Flat or rolling terrain (%)	Remote location (%)	Trees integrated with other crops (%)	Under dense canopy (%)
Libagon (12)	42	58	17	67	8
Dulag (7)	0	100	0	100	0
Leyte Leyte (3)	0	100	0	67	33
Bato (6)	17	100	0	67	0
Total (28)	21	82	7	75	7

eroded, sites dominated by imperata (hapludand/humitropept soils), four relatively fertile farm sites (eutropept soils) and four sites adjacent to rice fields (eutropept/tropaquept soils) were 57, 135 and 187 cm,⁶ respectively. Tree growth on these sites is consistent with the fertility of the three soil associations (described by Baynes et al. 2007) on which they were planted.

The area of all but three sites was approximately 0.1 ha and typically represented a small portion of a farm which was presently under-utilised, or a separate parcel of land which was moderately distant from the family home and from which farmers stated that annual crops were liable to be stolen. In all four municipalities, only three sites were approximately one hectare in size and in each case the farm was planted to trees because the owner was retired and unable to farm their land intensively.

Suitability of Planting Sites Chosen by Farmers

Extension staff had no input into farmers' choice of planting site and in many cases it had not been possible for them to visit the sites before seedlings were planted. The characteristics of the planting sites chosen by farmers were broadly similar (Table 4) for both pairs of municipalities. Only 21% of sites overall were situated on infertile or eroded steep sites. Most tree planting (82% overall) occurred on flat or rolling terrain and even in the most mountainous municipality, Libagon, 58% of sites were planted on land with a slope of less than 15°. Only 7% of sites (two sites in Libagon) were situated in a remote location where access for harvesting would be

⁶ The standard deviation of the means was 16, 32 and 41 cm, respectively.

difficult. Trees were integrated with other crops in 75% of sites, the most common situation being planting tree seedlings underneath coconuts and bananas. However, in 7% of the sites, trees were planted under a dense canopy where the mahogany seedlings were unlikely to receive enough sunlight to grow to merchantable size.

The overall percentage of sites which are infertile, eroded, steep, sited in a remote location or underneath a dense canopy was 35% (Table 4). Trees planted on these sites are unlikely to grow to produce commercial sawlogs (typically 200×200 mm squared flitches of various lengths) within the commonly quoted timeframe of 10–15 years for commercial trees in Leyte.

The location of each farm was plotted onto a map of the terrain of Leyte Island (Fig. 4). In Bato and Leyte Leyte, farmers chose planting sites in the valleys leading to the sea. In Dulag, farmers planted trees adjacent to rice fields rather than on the

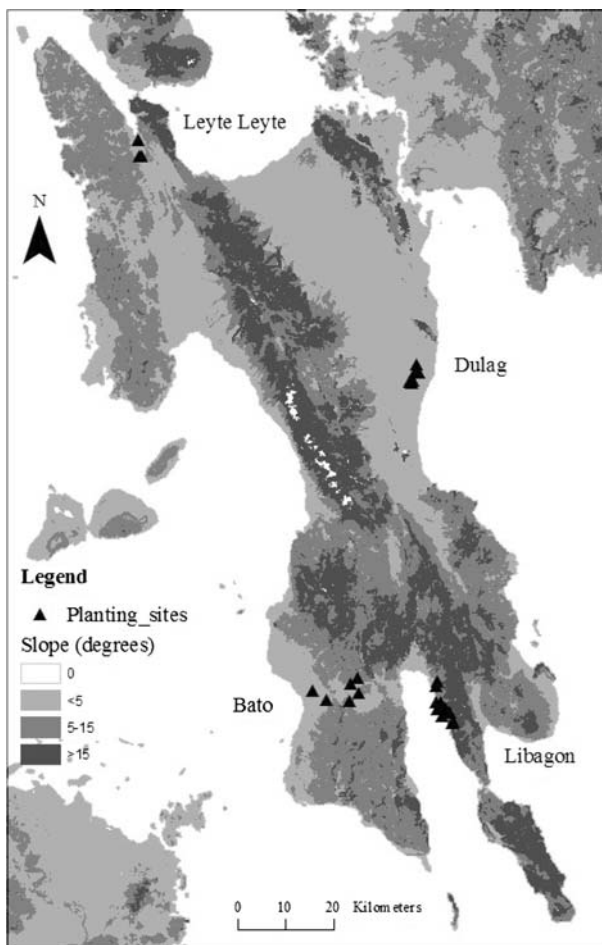
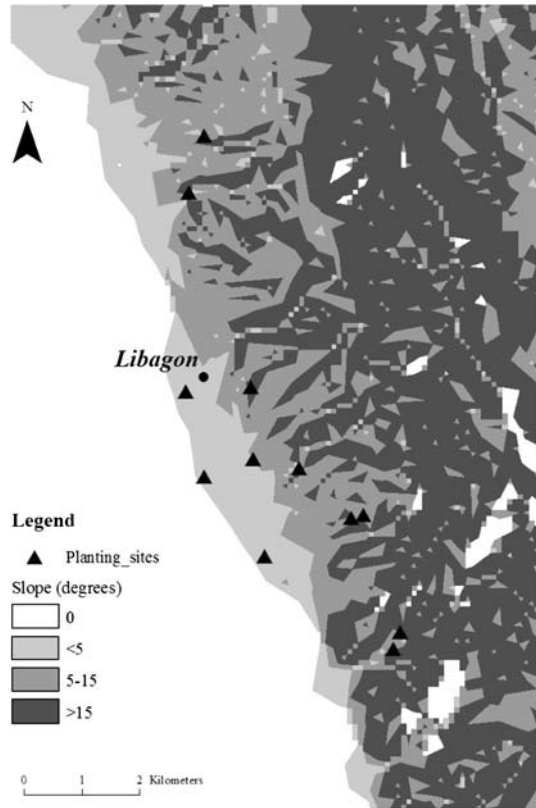


Fig. 4 Locations of 28 planting sites in the municipalities of Leyte Leyte, Dulag, Libagon and Bato, Leyte island

Fig. 5 Locations of 12 planting sites on the lowlands and mid-slopes of the municipality of Libagon



steeper land to the north and west, and in Libagon farmers planted trees adjacent to the coast as well as on the mid-slopes leading to the mountains (Fig. 5).

In all four municipalities, 21% of sites were classified as being fire-prone, i.e. steep, and covered with imperata which dries off in the dry season to produce a flammable understorey. Extension staff considered that the incidence of flood-prone sites was unduly weighted by three sites which were planted on the Dagitan River in Dulag. However, 11% of sites were situated on land adjacent to rice fields and trees on these sites were considered to be prone to damage in typhoons because they are not protected by surrounding vegetation and because of the restricted vertical root development of trees growing in this situation. Therefore, on 32% of sites overall trees may be considered as being liable to damage from either fire or typhoons in their early years.

Farmers' Final Evaluation of the Extension Program

Farmers' responses to questions in a final interview were coded into general themes which provided insights for the conduct of a hypothetically expanded program. Farmers in Libagon and Dulag all made comments about the growth of their seedlings (e. g. slow growing or affected by tip borer) which indicated that they had

taken a keen interest in seedling growth. In Leyte Leyte and Bato, 33% of farmers criticised the seed as being of low quality, even though their neighbours achieved excellent germination results. In response to a question about what advice they would offer for future ACIAR programs, a high proportion of farmers (62%) prioritised provision of technical advice ahead of material assistance and finance. Ninety percent of farmers also indicated a strong preference for advertising a similar program through personal contact or in individual villages rather than through demonstration farms or signs.

Thirteen farmers in Libagon and Dulag were asked to list neighbours or family with whom they had discussed or shown their trees. The farmers were able to list 51 neighbours or family, and 15 neighbours were interviewed by extension staff. Almost all (14) of the neighbours expressed interest in being included in a potential expansion of the program.

Discussion and Concluding Remarks

The data gathered in the two pairs of municipalities provided a chain of evidence which was often complementary or additive in addressing the effectiveness of the program in terms of the four evaluation criteria.

Criterion 1, Recruitment of Farmers to the Extension Program

For the first criterion, recruitment of farmers in all four municipalities was consistently low, even though invitations to participate in the program were distributed by LGU staff and no restrictions were placed on participant numbers. The mix of relatively wealthy and poorer farmers at the field days suggests that the recruitment process was not biased. However, the demographic characteristics of those farmers who subsequently participated in the program indicate that they constituted a cohort of smallholders who are relatively well-off, have secure title to relatively large areas of land and are semi-retired or have outside employment. A major constraint to agroforestry adoption in Panama—complicated harvesting legislation (Fisher and Vasseur 2002)—did not apply in this program because most farmers indicated that they would avoid harvesting legislation by using trees for on-farm use. A complementary issue to the low recruitment of farmers is that the sub-hectare area of most plots suggests that similar to the findings of Bannister and Nair (2003) in Haiti (where typical landholdings are smaller than 3 ha), trees are planted in hundreds, not thousands.

The failure of signs as a method of recruitment may be explained by farmers' strong preference for recruitment to be made at the personal or barangay level. Despite the political necessity for access to communities to be made with the cooperation of municipal mayors and LGU staff, the results suggest that the large number of interested neighbours who attended the nursery demonstrations and expressed interest in growing trees are a cohort of farmers who would welcome extension assistance. Extension staff suggested that political affiliations may have prevented some farmers being invited to join the extension program.

Overall, the experience of this program suggests that improved recruitment levels may be achieved by a two-stage process, first by establishing trust and rapport with a first cohort of farmers, as happened in this program, and then by using them as the traditional ‘farmer-champions’ in order to recruit more farmers at the barangay or neighbourhood level.

Criterion 2, Farmers’ Response to Extension Techniques and the Delivery of Technical Information

For the second criterion, evidence documenting the transfer of home nursery and tree establishment technology was unequivocal in confirming the effectiveness of extended assistance compared to limited assistance. Farmers’ prioritisation of technical assistance above financial assistance indicated that tree growing is not feasible for many Filipino farmers unless they are taught how to cope with the problems which arise. This response is consistent with the willingness of almost all farmers in Libagon and Dulag to act on technical advice and the low rate of abandonment of nurseries by farmers in these municipalities compared to farmers in Leyte Leyte and Bato municipalities. By restricting the main extension input to technical advice, the program avoided creating the dependency relationship between farmers and extension staff which is described by Franzel et al. (2002) as potentially introducing bias in farmers’ responses, and by Chokkalingam et al. (2006) as reducing their personal investment.

Technology transfer during plantation set-out, planting and staking was also only successful when farmers received on-site assistance. Murray and Bannister (2004) reported that extension programs in Haiti encourage farmers to make decisions concerning final seedling deployment, but in this program farmers did not prove adept in setting out plantations. When verbal descriptions and extension literature were used as a substitute for on-site visits, some farmers planted seedlings adjacent to mature coconuts or underneath dense canopies where the seedlings will become suppressed.

Effective technology transfer was also observed to be time-dependent. Ideally, the timeframe for assistance should be extended until trees have outgrown weeds. Fortunately, most sites on which farmers chose to plant trees were on fertile soil and flat or rolling terrain. Trees planted on these sites were observed to have grown through the weeds in the first year. However, while Harrison et al. (2000) noted that the main opportunity to reforesting land in the Philippines is on the sloping upland areas which are not suitable to annual crops, few sites in these areas were chosen.

For the 21% of sites overall which were situated on infertile soil dominated by imperata, abandonment of weed control before trees are fully established may substantially reduce their growth. The traditional silvicultural techniques of fertilising or ploughing are not feasible on these sites because of the expense of fertiliser and steepness of the terrain. An alternative view of farmers’ reluctance to control weeds on these sites is that the sites complied with a key requirement for agroforestry proposed by Cannell et al. (1996)—that trees should use resources that crops do not—because the land was unused or underutilised. Farmers may have understood and accepted the technology of tree establishment, but on infertile

sites—using Cramb's (2000, p. 12) metaphor of farmers 'shopping around for technological ingredients which they incorporate into their own recipes'—they selectively applied it. Deliberate use of an agroforestry system in which trees are integrated with annual crops, as reported by Nissen et al. (2001) and Bertomeu et al. (2006) on the nearby island of Mindanao, was minimal.

Criterion 3, Farmers' Enthusiasm and Commitment

For the third criterion, evidence of the effect of extended assistance in maintaining farmers' commitment to the establishment and maintenance of their trees was provided in a higher percentage of sites in Libagon and Dulag for which intensive site preparation, fertiliser or fencing was used, compared to Leyte Leyte and Bato. The higher abandonment of sites in Leyte Leyte and Bato suggested a lower level of farmers' personal commitment in these municipalities. However, even in Libagon and Dulag, the high level of sites which were not being maintained 1 year after planting (38%) suggested that, by the end of the program, enthusiasm for site maintenance was waning.

Farmers' attitudes and commitment to the program were also affected by the destruction of sites by natural disasters. The high percentage of all sites being at risk from fire or typhoon (32%) presents a public relations challenge because a more interventionist approach to deciding the suitability of sites may reduce recruitment, but a *laissez-faire* approach to site selection may result in public relations problems in subsequent years. Protection of seedlings from grazing may be reduced by temporary fencing constructed of split bamboo or tree branches. However, protection of seedlings from fire is more difficult, and Tacconi et al. (2007) suggested that in the tropics fires must be seen as a land management process rather than just a problem to be suppressed or mitigated. In any case, Murdiyarso and Lebel (2007) suggested that reducing the incidence of fire in Southeast Asia through regulations may be impeded by a lack of independent and effective judicial systems. In this situation, the best approach by extension workers may be to encourage neighbour-to-neighbour cooperation.

Criterion 4, Shifting the Initiative for Planting of New Areas from Extension Staff to Farmers

For the fourth criterion, the timing of the final survey, only 1 year after initial planting, was such that minimal adoption and diffusion had occurred. It is possible that farmers are adopting their traditional 'wait and see' attitude to agricultural innovations. However, the universal support for the program by farmers whose sites were not destroyed is encouraging. For farmers in Libagon and Dulag, the program has shifted the initiative for growing further trees from extension staff to farmers. For those farmers who accepted the full extension package, a 'top-down' delivery of technical information supported by encouragement and personal farm visits has been successful and these farmers do not need further assistance. In contrast, limited extension assistance without encouragement and reinforcement of technical principles did not engender commitment and self-efficacy in Leyte Leyte and Bato.

The spontaneous interest by neighbours in nursery demonstrations at the homes of host farmers is promising for self-recruitment for a continuing program rather than diffusion. Consequently, comments from both extension staff and LGU officials that silvicultural techniques are not well understood by farmers, suggests that a quick exit strategy for a program of this nature is not possible. The cost of extension assistance per farmer is likely to be high. However, for this program, the unfailingly diplomatic hard work of extension staff provides an effective model for future agroforestry extension in Leyte.

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